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and  $N'$  is also the foot of a perpendicular on  $BC$  from  $P$ , the foot of a perpendicular from  $A$  to  $BDC$ .

Since for different tetrahedra  $P$  becomes any point in plane  $BCD$ , the following theorem is obtained (Fig. 3): If from a point ( $P$ ) perpendiculars be drawn to the sides of a triangle ( $BCD$ ) produced if necessary, and their feet ( $L'M'N'$ ) be joined to the opposite vertices, the three intersections of these lines with the parallels to the sides through the median point ( $LMN$ ) and the median point ( $A'$ ) lie on a circle whose center divides the join of the circum-center of the original triangle and the center of mean position of the three vertices of the triangle and the arbitrary point externally in the ratio 1 : 4. The second part of the theorem follows from the fact that  $B'C'D'$  and  $BCD$  (Fig. 2) are similarly situated with respect to the center of mass of the four vertices of the tetrahedron, and the orthogonal projection of the circum-center of  $A'B'C'D'$  on plane  $BCD$  coincides with that of the circum-center of triangle  $B'C'D'$ .

## QUESTIONS AND DISCUSSIONS.

EDITED BY W. A. HURWITZ, Cornell University, Ithaca, N. Y.

### NEW QUESTIONS.

37. Criticise the following as fundamental definitions of elementary geometry:

A plane surface is the limit approached by a finite portion of the surface of a sphere as the radius increases without limit.

A straight line is the limit approached by a finite portion of the circumference of a circle as the radius increases without limit.

38. As the several courses in secondary and collegiate mathematics are now taught there is a noticeable difference of treatment with respect to the relative emphasis placed on logical accuracy and on development of technique. In elementary algebra, technique predominates, while in plane and solid geometry and advanced algebra logic is more strongly stressed. Trigonometry, analytic geometry, and the calculus are less easily classified; but there is at least a general tendency to emphasize logic in analytic geometry and technique in the calculus. It is suggested that a general appraisal of the reasons for this difference in treatment, its value, and possible alterations, would be helpful.

### DISCUSSIONS.

THE EXISTENCE OF CUSPS ON THE EVOLUTE AT POINTS OF MAXIMUM AND MINIMUM CURVATURE ON THE BASE CURVE.

By G. H. LIGHT, University of Colorado.

The purpose of this paper is to show that whenever a curve  $F(x, y) = 0$  has a point of maximum or minimum curvature the evolute has at the correspond-